# DETECTION OF AMMONIA IN NEAR INFRARED REGION CONSIDERING THE EFFECT OF CROSS SENSITIVITY

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# ABSTRACT

Ammonia gases have their own advantages and disadvantages; however it is important to monitar ammonia emission to avoid hazardous level. Ultraviolet or broadband Infrared absorption, and Photothermal Deflection prevent the species-conversion, time delay, and adsorption problems associated with traditional sampling systems, but often use expensive, bulky or delicate radiation sources that are not suitable for commercialisation. In gas detection, cross sensitivity is one of the constraints since the air consists of a variety of gases. A few techniques were introduced such as using gas separation techniques or ratio calculation to overcome the problem. For ammonia gas sensing, it has been reported that the cross sensitivity with humidity is the main problem and this occurs in certain wavelength ranges. This is a strong indication that cross sensitivity for ammonia emission monitoring must be modelled. Choosing suitable wavelength of ammonia with minimal cross sensitivity effect can reduce the effect of cross sensitivity at infrared region. In this numerical prediction analysis, the optical transmission of ammonia was obtained through a model developed using a commercial simulator SpectralCalc-GATS, OptiSystem and Matlab. The developed model is then interfaced with the integrated sensor system model using OptiSystem for system performance and characterisation. The simulation shows that ammonia absorption cross section within 2200 nm to 2400 nm region has less cross sensitivity issues. It is not possible to discuss the cross sensitivity issue for every single atmospheric gas as there are too many gases in the atmosphere and the amount is small and subject to the surrounding environment. These simulations consider other gases such as $CO_2$ and $H_2O$ Proper cross sensitivity is able to be simulated and characterised through the sensor model developed through this research.

# ABSTRAK

Gas ammonia mempunyai kelebihan dan kekurangan yang tersendiri; walau bagaimanapun, pembebasan ammonia adalah penting untuk dipantau bagi mengelakkan daripada berlakunya pembebasan gas yang berbahaya. Ultraungu atau penyerapan jalur lebar Infrared, dan Pesongan Photothermal mengelakkan spesis penukaran, masa tunda, dan penyerapan masalah yang berkaitan dengan sistem pensampelan tradisional, mahal, sumber radiasi yang besar atau halus yang tidak sesuai untuk dikomersialkan. Beberapa teknik telah diperkenalkan seperti menggunakan teknik pemisahan gas atau pengiraan nisbah untuk mengatasi masalah ini. Bagi pengesan gas ammonia, ia telah dilaporkan bahawa sensitiviti rentas dengan kelembapan adalah masalah utama dan berlaku dalam julat panjang gelombang tertentu. Ini menunjukkan bahawa sensitiviti silang untuk pemantauan pelepasan ammonia mesti di modelkan. Pemilihan panjang gelombang ammonia yang sesuai boleh mengurangkan masalah sensitiviti silang pada kawasan infrared. Dalam analisis berangka ini, penghantaran optik ammonia telah diperolehi melalui model yang dibangunkan dengan menggunakan simulator komersial *SpectralCalc-GATS*, *OptiSystem* dan Matlab. Model yang dibangunkan kemudian bersepadu dengan sistem model menggunakan *OptiSystem* untuk prestasi sistem dan pencirian. Simulasi menunjukkan bahawa ammonia penyerapan keratan rentas dalam 2200 nm untuk 2400 nm menghadapi kurang masalah sensitiviti silang. Ianyad tidak mungkin untuk membincangkan isu sensitiviti rentas untuk setiap gas atmosfera tunggal kerana terdapat terlalu banyak gas di dalam atmosfera dan jumlah tersebut adalah kecil dan tertakluk kepada alam sekitar. Simulasi ini mempertimbangkan gas lain seperti $CO_2$ dan $H_2O$. Melalui model sensor yang dibangunkan melalui penyelidikan ini, kepekaan sensitiviti silang mampu untuk disimulasikan dan dicirikan.

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